DIPLOPODA IN A SECONDARY SOIL SUCCESSIONAL ROW

BY

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Summary: Structure and activity of millipede communities in a secondary soil successional row (field, abandoned field, meadow developed from field and forest corresponding to climax stage) were studied from April 1986. Animals were extracted from soil samples, data about activities of millipedes on the areas and about immigration on the abandoned field from surrounding habitats were obtained by pitfall trapping. Surface activity on the abandoned field was nearly half of that in the meadow as early as on the first year, when the number of trapped species increased in connection with development of vegetative cover and increasing supply of dead plant material. The first juvenile stages of millipedes occurred on abandoned field in the spring of the second year. The highest number of species and abundance were on meadow area (12 species, 84.2 ind. m^{-2}), while forest area was lower in both these characteristics (8 species, 38.6 ind. m^{-2}).

The succession and trophic structure of the soil invertebrate communities were studied in different suburban fallow areas (Strueve-Kusenberg, 1981, 1982) and in reclaimed dumps (Dunger, 1968; Neumann, 1971). This paper deals with structure and activity of millipede communities in the secondary soil successional row on the plots originally cultivated.

STUDY SITES AND METHODS

The examined areas, all on brown forest soils, are situated near Chelčice and Netolice in South Bohemia (480m-560m a.s.l., yearly mean air temperature 7.3°C, precipitations per year 650 mm). The studied row includes (each area with at least 700 m^2): 1–field in crop rotation, in 1986 sowed by wheat, in 1987 set by potatoes. 2–just abandoned field, from autumn 1985 without crop rotation, vegetative cover in the first year was *Apera spica-venti* community. 3–meadow developed from field after 8-10 years with a vegative cover of *Agropyron repens* – *Holcus mollis* type. 4–deciduous forest corresponding to a climax stage of this region, 60-70 years old, vegetative cover consisting of *Quercus robur, Fraxinus excelsior, Tilia cordata, Acer pseudoplatanus*. In connection with studying of settling on area 2, surface activity on two neighbouring areas has been studied: 5–fallow land 4-6 years old, 10m wide zone situated beside area 2, vegetative cover *Urtica dioica–Aegopodium podagraria*, and 6–coniferous forest (*Picea excelsa*).

On the areas 1, 2, 3 and 4, the soil samples were taken monthly (5 from each site, area 1/16 m², depth 10 cm) as from May 1986 and extracted by modified Kempson extraction apparatus (Kempson et al., 1963). Pitfall traps (emptied every two weeks from April 1986) were situated on the areas 2, 3 and 4 ten in number, on the areas 5 and 6 five in number. On the area 1 there were no traps on account of frequent agrotechnical interference.

Two species, *Iulus scandinavius* Latzel and *Leptoiulus marcomannius* (Verhoeff) are not distinguishable in stages I to VI without mistakes (Meyer, 1985). A similar situation appears in two species of the genus *Unciger* Brandt, where only starting from stage VII it was possible to separate both species. Therefore these juvenile stages in both couple of species are taken together.

Millipedes in single areas of row

In all, the presence of 12 species of Diplopoda was established in the studied successional row. *Polyxenus lagurus* (Linnaeus) was found only under the bark of trees and is not recorded in table 1.

Area 1. Data from extraction of soil samples only show very low abundance (1.1 ind. m^{-2}). Two species were present here.

	pitfall traps					soil samples				abundances (m^{-2})			
	2	3	4	5	6	1	2	3	4	1	2	3	4
Glomeris hexasticha Brandt	9	15	181	78	48	-	-	26	100	-	-	6.9	24.6
Iulus scandinavius Latzel	63	126	11	63	72	1	1	39	-	0.3	0.3	10.4	-
Leptoiulus marcomannius (Verhoeff)	3	2	9	9	28	-	-	2	-	-	-	0.5	-
Iulus and *Leptoiulus* sp. (juv.)	-	36	8	30	3	-	-	132	1	-	-	35.2	0.2
Unciger foetidus (C. L. Koch)	1	2	110	26	-	-	-	3	8	-	-	0.8	2.0
Unciger transsilvanicus (Verhoeff)	5	11	-	16	2	-	-	4	-	-	-	1.1	-
Unciger sp. (juveniles)	-	-	1	-	-	-	-	14	43	-	-	3.7	10.6
Megaphyllum projectum kochi (Verh.)	32	41	2	20	100	-	4	13	-	-	1.1	3.5	-
Ommatoiulus sabulosus (Linnaeus)	2	4	-	-	1	-	-	63	-	-	-	16.8	-
Mastigona mutabilis (Latzel)	17	50	4	15	44	-	-	2	1	-	-	0.5	0.2
Haasea germanica (Verhoeff)	1	1	-	3	-	-	-	2	-	-	-	0.5	-
Ochogona caroli (Rothenbuehler)	5	19	4	34	6	-	-	1	-	-	-	0.3	-
Polydesmus complanatus (Linnaeus)	-	3	18	-	7	-	-	-	4	-	-	-	1.0
Polydesmus denticulatus C. L. Koch	-	16	-	39	40	3	-	15	-	0.8	-	4.0	-
Total										1.1	1.4	84.2	38.6

Tab. 1. The species of Diplopoda collected at study sites and their abundances. 1-field, 2-abandoned field, 3-meadow, 4-deciduous forest, 5-fallow land, 6-coniferous forest

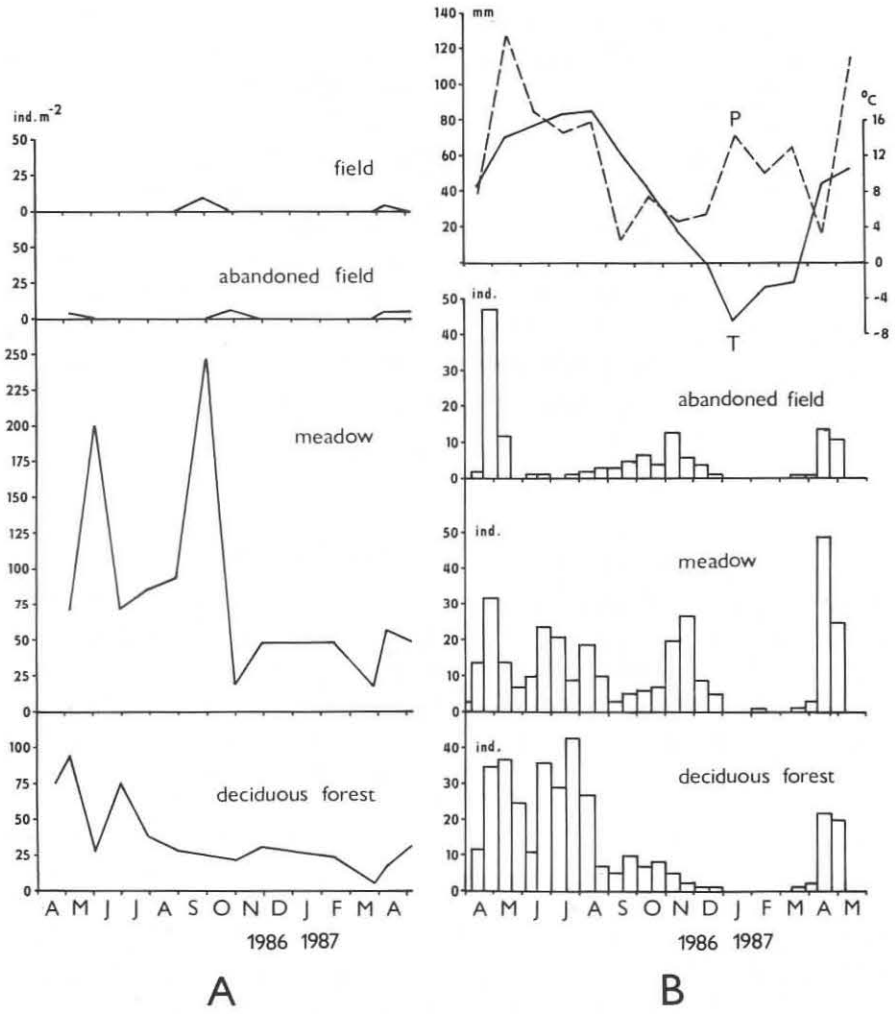

Fig. 1. Phenology of Diplopoda in single areas of successional row, A – abundances calculated from five soil samples, B – total catches in ten pitfall traps, T – mean monthly temperature and P – monthly precipitations according to climatic station Chelčice.

Area 2. Only mature *I. scandinavius* and *Megaphyllum projectum kochi* (Verhoeff) were noted in 1986 soil samples. In spring 1987, juvenile stages of *M. projectum kochi* were extracted. The mean abundance was 1.4 ind. m^{-2}. Pitfall trapping documented a rich surface activity of millipedes. Out of 10 species, *I. scandinavius* and *M. projectum kochi* were dominant. The immigration from areas 5 and 6 to this area will be noted below.

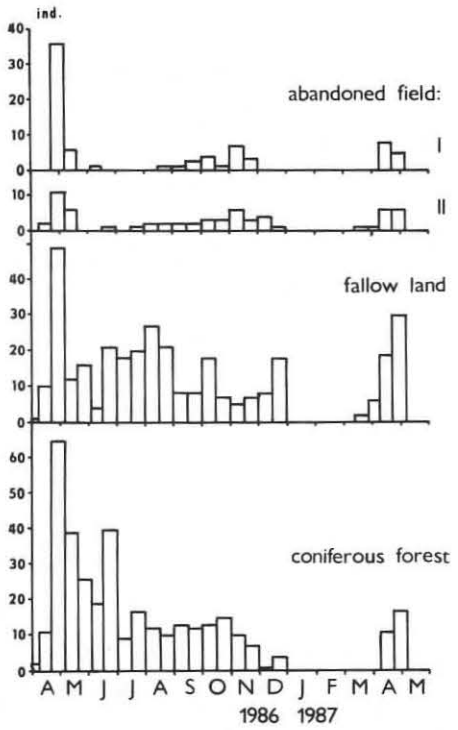

Fig. 2. Immigration of Diplopoda on the abandoned field, total catches in five pitfall traps, I and II — the first and second rows of five traps on abandoned field.

Area 3. 12 species were noted here. Abundance show outstanding swings in the course of the year. High values in June (198.4 ind. m^{-2}) and in September (246.4 ind. m^{-2}) were given by the presence of a high number of juvenile stages of *I. scandinavius/L. marcomannius* and *Ommatoiulus sabulosus* (Linnaeus) respectively. The mean abundance of this area was 84.2 ind. m^{-2}. Juvenile stages of *I. scandinavius/L. marcomannius* constituted 42% out of the total of extracted animals. With the rate of mature *I. scandinavius* and *L. marcomannius* 19.5: 1 we can presuppose that the majority of juvenile stages belong to *I. scandinavius*, which was the predominant species of this area.

Area 4. The highest values of abundance were noted in the first months of investigation (96.0 and 76.8 ind. m^{-2}), the mean abundance was 38.6 ind. m^{-2}. 8 species were found, in the whole population of millipedes *Glomeris hexasticha* Brandt (63.7%) and *Unciger foetidus* (C. L. Koch) (27.4%) participated above all.

Immigration of millipedes in the abandoned field

Adjacent and more stable surrounding habitats are sources for settlements of new stands (Strueve-Kusenberg, 1981). Our situation is documented in Fig. 2. Each of the four graphs comprises data from five pitfall traps. The sequence of graphs corresponds to the situation in the field. The areas 6 and 5 showed a rich millipede fauna, of which (in the first year of succession) penetrated into the area 2 such species as *G. hexasticha, Mastigona mutabilis* (Latzel), *I. scandinavius*, *M. projectum kochi. L. marcomannius*, abundant in area 6, spread into areas 5 and 2, too. *Ochogona caroli* (Rothenbuehler) and *Unciger transsilvanicus* (Verhoeff), with the highest values of activities in area 5, spread into area 2 and area 6, too. *O. sabulosus* penetrated into area 2 probably from contact places with area 3.

Discussion

A low abundance of millipedes was noted in the field and in abandoned field. Pitfall trapping in abandoned field shows that into this station with the last vegetative cover penetrated at first mature specimens of Julida. With development of vegetation and increasing of dead organic material on the soil surface in area 2, species of Chordeumatida appeared towards the end of the first year of succession. Presence of juvenile stages of Julida in the spring of the second year confirmed probably the beginning of the permanent settlement on abandoned field.

According to the studied areas of the secondary soil successional row the number of species and their abundance increased towards the meadow community and then decreased in forest community. In meadow community, the spring peaks of millipede surface activities are due to the dominant species *I. scandinavius*, while that in autumn is due to *Mastigona mutabilis*. *O. caroli* stayed active on these places even under snow cover. Millipede population of the deciduous forest had a more stable character with two dominant species and subdominant and recedent species, which were concentrated above all on places with accumulated damp leaves litter and decayed wood.

References

Dunger, W., 1968. Die Entwicklung der Bodenfauna auf rekultivierten Kippen und Halden des Braunkohlentagebaus. Abhandlungen und Berichte Naturkundemuseum Goerlitz, 43 (2): 1-256.

Kempson, D., M. Lloyd & R. Ghelardi, 1963. A new extractor for woodland litter. Pedobiologia, 3:1-21.

MEYER, E., 1985. Distribution, activity, life-history and standing crop of Julidae (Diplopoda, Myriapoda) in the Central High Alps (Tyrol, Austria). Holoarct. Ecol., 8, 2: 141-150.

NEUMANN, U., 1971. Die Sukzession der Bodenfauna (Carabidae, Coleoptera; Diplopoda und Isopoda) in den forstlich rekultivierten Gebieten des Rheinischen Braunkohlen-reviers. Pedobiologia, 11: 193-226.

STRUEVE-KUSENBERG, R., 1981. Sukzession und trophische Struktur der Bodenfauna von Brachlandflächen. Pedobiologia, 21: 132-141.

——, 1982. Succession and trophic structure of soil animal communities in different suburban fallow areas. In: R. BORNKAMM, J. A. LEE, M. R. D. SEAWARD (eds.): Urban Ecology., 89-98, Oxford, London, Edinburgh, Boston, Melbourne.